

Figure 1(a) 6" x 6" setup reticle for the preferred embodiment (10 x 12 field point array)

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Figure 1(e) - detail of field point the near circular region is near a 15 x 15 a 21 x 21 array of outer frame structures 550 um alignment attributes - however, structures ~400um in diameter Each field point contains array of frame-in-frame Field point number at wafer level Wafer Notch One Exposure Wafer ready for overlay Exposure field measurement embodiment of preferred

Figure 1(d) Preferred embodiment - typical wafer level exposure pattern

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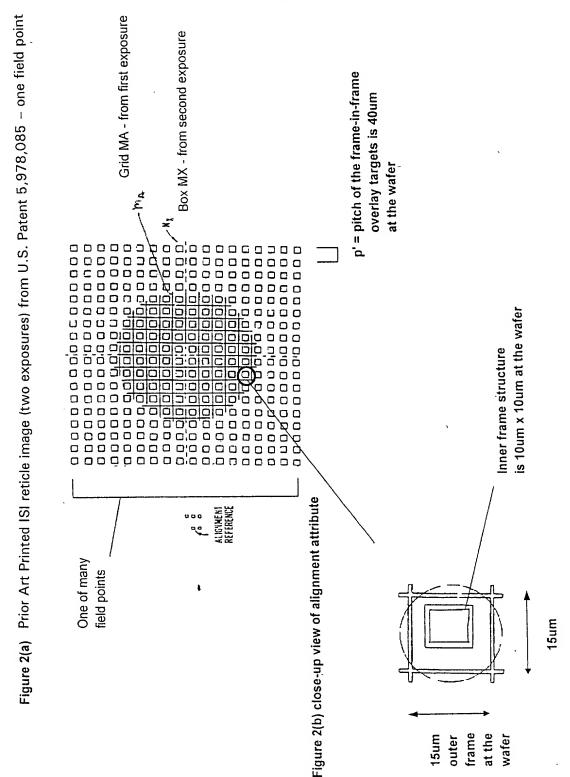


Figure 3 Diagram of ISA coordinates for a given field point

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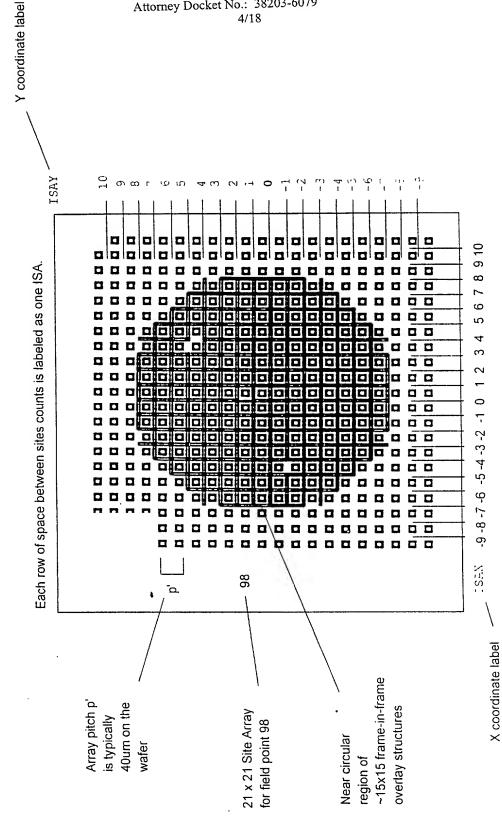
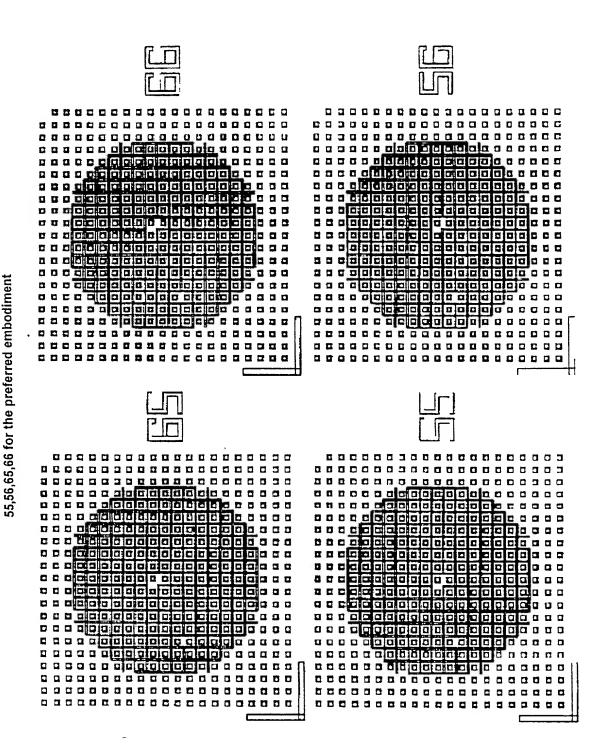


Figure 4(a) Site arrays of field points

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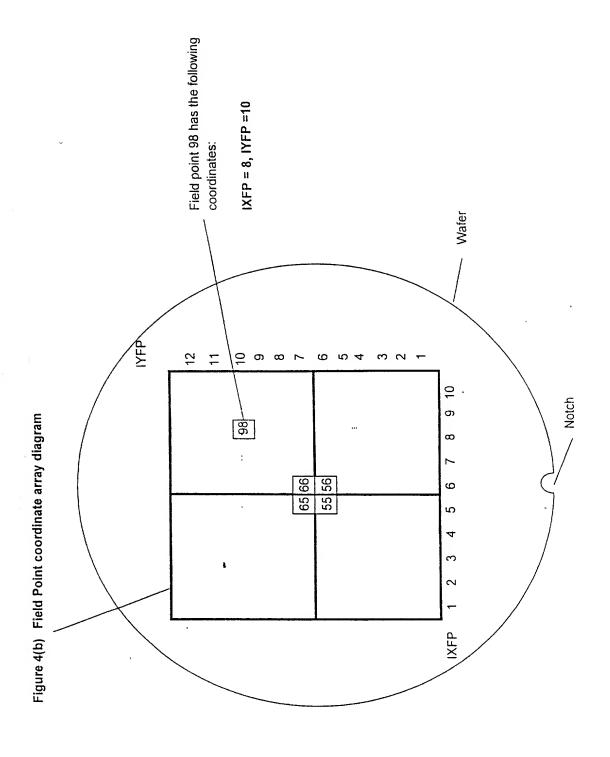


Figure 5(a) Sign convention for BBX and BBY offsets and fourth encoding scheme at wafer level

The small inner frame is shown mis-aligned to the larger outer frame this produces

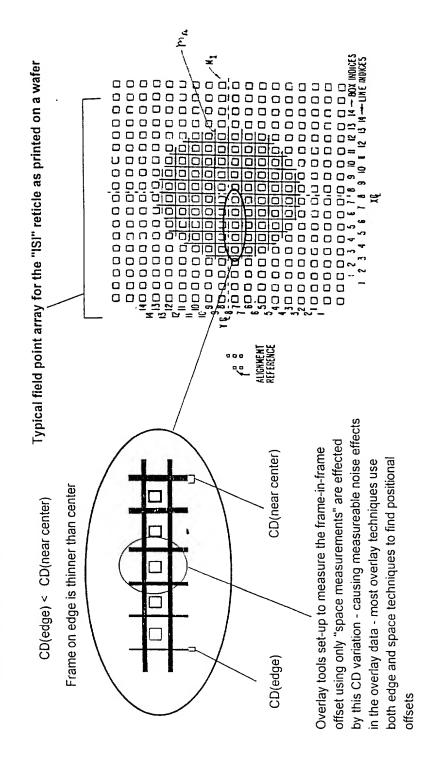
an x-shift and y-shift overlay positional offset (+BBX and +BBY)

+BBX, +BBY Offset Vector shows Perfect alignment MA outer frame mis-alignment 502 Vertical bar CD #2 MX inner frame Vertical bar CD #1 Horizontal bar CD #2 Horizontal bar CD #1 +Y direction +X direction

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Figure 5(b) Typical Overlay errors



Overlay measurements using CD or edge techniques

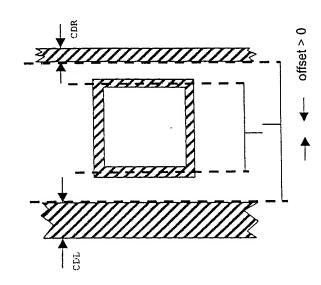
Overlay measurements using space techniques

space

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measurement producing non zero offset in presence of CD variation (CDL > CDR) Figure 5d, Bar in box or frame in box

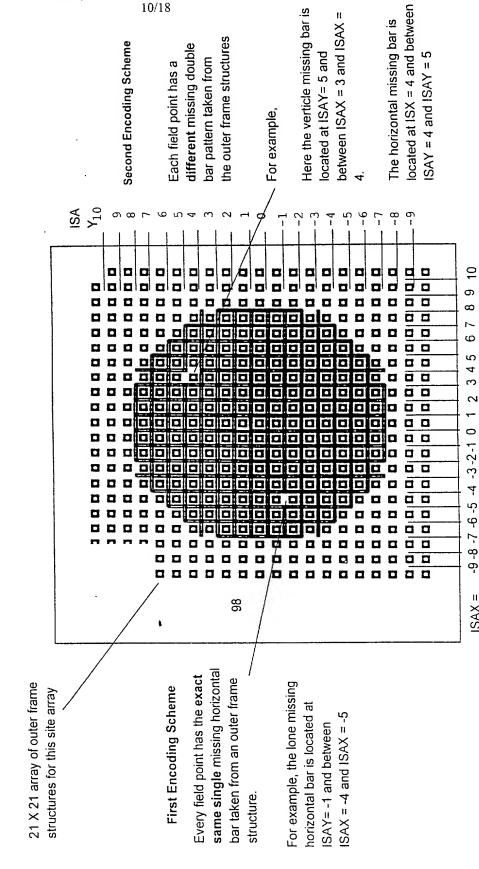


offset=0

measurement producing 0 offset in presence of Figure 5c, Bar in bar or frame in frame CD variation (CDL > CDR).

Figure 6 First two encoding schemes - missing-bar layout for field point 98

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ISAX =

17 0 = 14	4				0 563	0 563 0 0625	0 625 0 563 0 125 0 125	0 625 0 563 0 1875 0 1875	0 625 0 563 0 25 0 25	0 625 0 563 0 3125 0 3125	0 625 0 563 0 375 0 375	0 563 0 4375	0 563 0 5				
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DS/DSQ_W=	α		0 375 -0 125	0 375	0 375	0 375 0 0625	0 375 0 125	0 375 0 1875	0 375 0 25	0 375 0 3125	0 375 0 375	0 375 0 4375	0375	0 375 0 5625	0 3,75 0 625		
O.		0 313	0 313 -0.125	0 313	0313	0 313 0 0625	0 313 0 125	0 313 0 1875	0 313 0 25	0 313 0 3125	0 313 0 375	0 313 0 4375	0313 05	0 313 0 5625	0 313 0 625	0 313 0 6875	
ç	10	0 250 -0 1875 -	0 250 -0 125	0 250 -0 0625 -	0 250 0	0 250	0 250 0 125	0 250 0 1875	0.250 0.25	0 250 0 3125	0 250 0 375	0 250	0.250 0.5	C 250 0 5625	0 250 C 625	C 25C 0 6875	
;	=	0 188 -0 1875 -	0 188 -0 125	0 188 -0 0625 -	0 189 0	0 188 0 0625	0 188 0 125	0 188 0 1875	0 188 0 25	0 188 0 3125	0 188 0 375	0.188 0.4375	0 188 0 5	0 188 0 5625	0 188 0 625	0 188 0 6875	
ç	2	0 125 -0 1875	0 125 -0 125	0 125	0 125 0	0 125 0 0625	0 125 0 125	0 125 0.1875	0 125 0 25	0 125 0 3125	0 125 0 375	0 125 0 4375	0 125 0 5	0 125 0 5625	0 125 0 625	0 125 0 6875	
ç	2	0 063 -0 1875	0 063 -0 125	0 063 -0 0625		0 063 0 0625	0 063 0 125	0 063 0 1875	0.063 0.25	0 063 0 3125	0 063 0 375	0 063 0 4375	0 063	0 063 0 5625	0 063 0 625	0 063 0 6875	
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Figure 8 location of (0,0) point of frame-in-frame data on setup reticle

1X0 1Y0 FP = position within 21 x 21 array where (BBx,BBy) = (0,0) occurs

= field point number

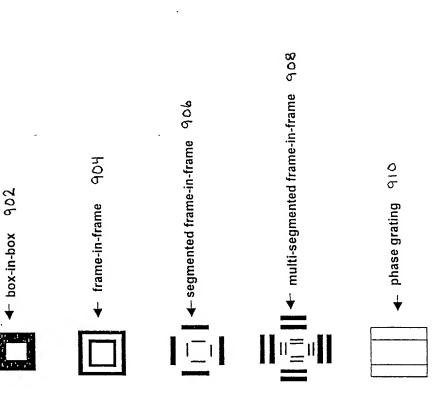
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Y=Row										
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	111	112	113	114	115	116	117	118	119	120
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8	13	13	13	13	13	13	13	13	13	13
	71	72	73	74	75	76	77	78	19	80
	?	8	9	10	11	12	13	14	15	1 6
7	12	12	12	12	12	12	12	12	1.1	1.
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IX=Col

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or completed alignment attributes Figure 9 Typical overlay patterns



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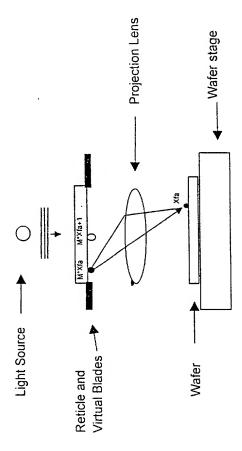
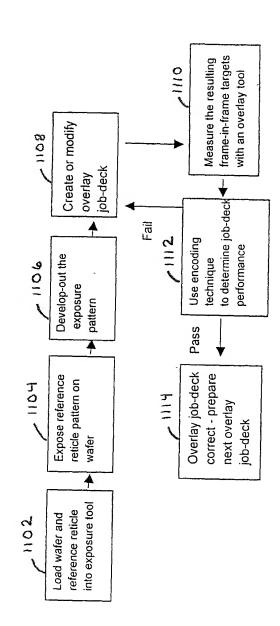


Figure 10 Photolithographic stepper or scanner system

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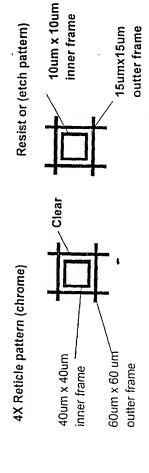
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Figure 12 Reticle and resist frame-in-frame description for a typical ISA coordinate site ISAX, ISAY



No shift: ISAX = 0, ISAY =0 Frame-in-Frame structure Figure 13 Centered

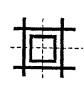
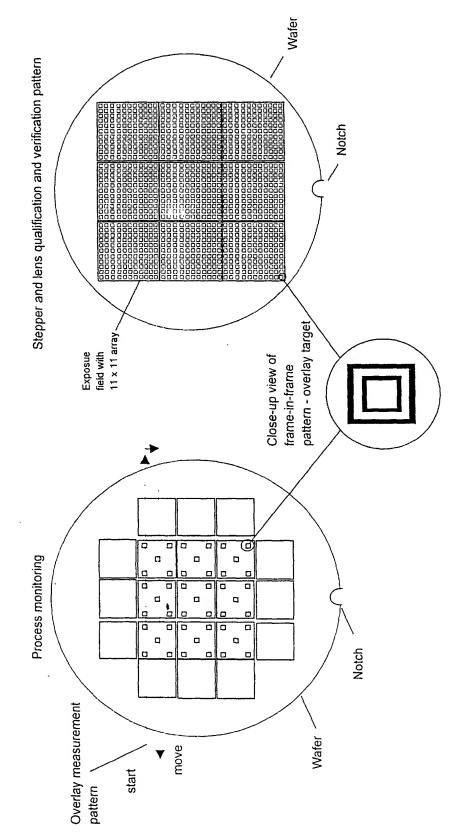


Figure 14 Prior art - exposure patterns: Process monitoring and Stepper qualification

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projection lens aberrations Calculate 1 process alignment Verify and correct overlay program determine the frame-in-frame targets performance Measure the resulting bool all available data with an overlay tool -Statistically 4 4 Perform overlay measurements Perform overlay overlay job-deck measurements Create Figure 15(c) Process flow for prior art - lens abberation measurement Remove invalid Figure 15(a) Process flow for prior art - Photolithographic tool set-up overlay data Figure 15(b) Process flow for prior art - Production use of overlay Develop-out the Pull 3 wafers from Program overlay tool to measure overlay targets production lot exposure for overlay sampling pattern random components of Statistically determine the systematic and intra-field error inter-field and Expose reticle Develop resist Develop resist pattern on patterns wafer patterns into exposure tool Load wafer and corrections to the production wafers Align and expose into the exposure Apply overlay and ISI reticle exposure machine oad wafer machine